Executive Summary

On July 14, 2004, an undergraduate student was injured at Los Alamos National Laboratory (LANL) while working with a Nd: YAG laser in the Chemistry (C) Division's Advanced Chemical Diagnostics and Instrumentation group (C-ADI). The incident occurred at Technical Area 46, building 41, room 106.

The principal investigator (PI) mentoring the student (S1) was working with her on an experiment involving two lasers, one (L1) to analyze particles and the other (L2) to generate and suspend the particles inside a vacuum chamber. However, on July 14 the PI used L1 in flash-lamp mode to illuminate rather than analyze the suspended particles. After firing and shutting down L2, the PI removed the beam stop from behind the sample chamber's rear window and looked inside while L1's flash lamps continued to operate. When S1 bent down to look too, she immediately saw a flash and a reddish brown spot in her eye. The injury was subsequently diagnosed as a laser-caused hole in the retina of S1's left eye.

An Accident Investigation Team (the Team), appointed by LANL Director G. Pete Nanos and working from July 19 to August 27, 2004, interviewed personnel, reviewed documents, and characterized systems and conditions in room 106. The PI reported that he was operating L1with the Q-switch trigger cable disconnected from the Stanford Research Systems (SRS) pulse generator. The Team's collected evidence confirmed that L1 could not lase under those conditions. However, because L1 *did* emit laser light on July 14, the Team believes, based on its collected evidence, the laser was operated in one of three possible lasing modes.

The Team determined that *direct* and *primary* Integrated Safety Management (ISM) failures leading to this accident were, respectively, the PI's unsafe work practices and the institution's inadequate monitoring of worker performance. These failures are briefly summarized here.

Direct ISM Failures

- Neither the PI nor S1 was wearing laser eye protection (LEP), and there were no engineered safety measures.
- The PI did not recheck beam alignment or laser condition or check for beam reflections on July 13 or 14.
- The PI prepared an insufficiently detailed integrated work document (IWD) and did not resubmit a modified hazard control plan (HCP) to reflect experimental changes.
- The PI did not give S1 proper pre-job training, and he asked S1 to sign and predate the IWD after the accident.

Primary ISM Failures

- Safety-responsible line managers (SRLMs) did not monitor the PI's safety practices or his workspace and did not ensure his adherence to Laboratory Implementation Requirements, Laboratory Implementation Guidance, and C-Division work/worker authorization procedures.
- SRLMs and the laser safety officer signed the PI's IWD without noting the lack of detail.
- Management did not ensure that S1 completed all prerequisites for work.
- LANL's Student Mentoring Program did not require mentor training or monitor students and their mentors.

The Team recommends the following:

- LANL should implement a risk-based oversight program that systematically monitors the performance of every employee and workspace.

- LANL should establish nonpunitive processes that emphasize peer-to-peer and worker-to-manager communication of unsafe acts and near misses. Such processes would create an environment of open communication, encouraging legitimate concern for individual safety.

- LANL should assess the safety of laser operations throughout the Laboratory.

- C-ADI should correct the safety issues inside building 41, including the overall poor state of housekeeping.

- C-Division should implement a process that ensures the quality of IWDs and HCPs.

- LANL should conduct a continuing, periodic review of the quality of IWM implementation.

- LANL should develop and implement a formalized student mentoring program that includes the following:

  – LANL must establish qualification and training requirements for mentors.

  – LANL must establish a monitoring and performance-asessment proram for mentors and students.

  – LANL must establish requirements for the mentors to teach their students how to work safely.

  – LANL must establish requirements for students to demonstrate their ability to work safely.

- C-Division should take actions to modify worker and manager behaviors through the use of existing institutional processes.

- LANL should address the concerns listed in Appendix H using the institutional issues management system.